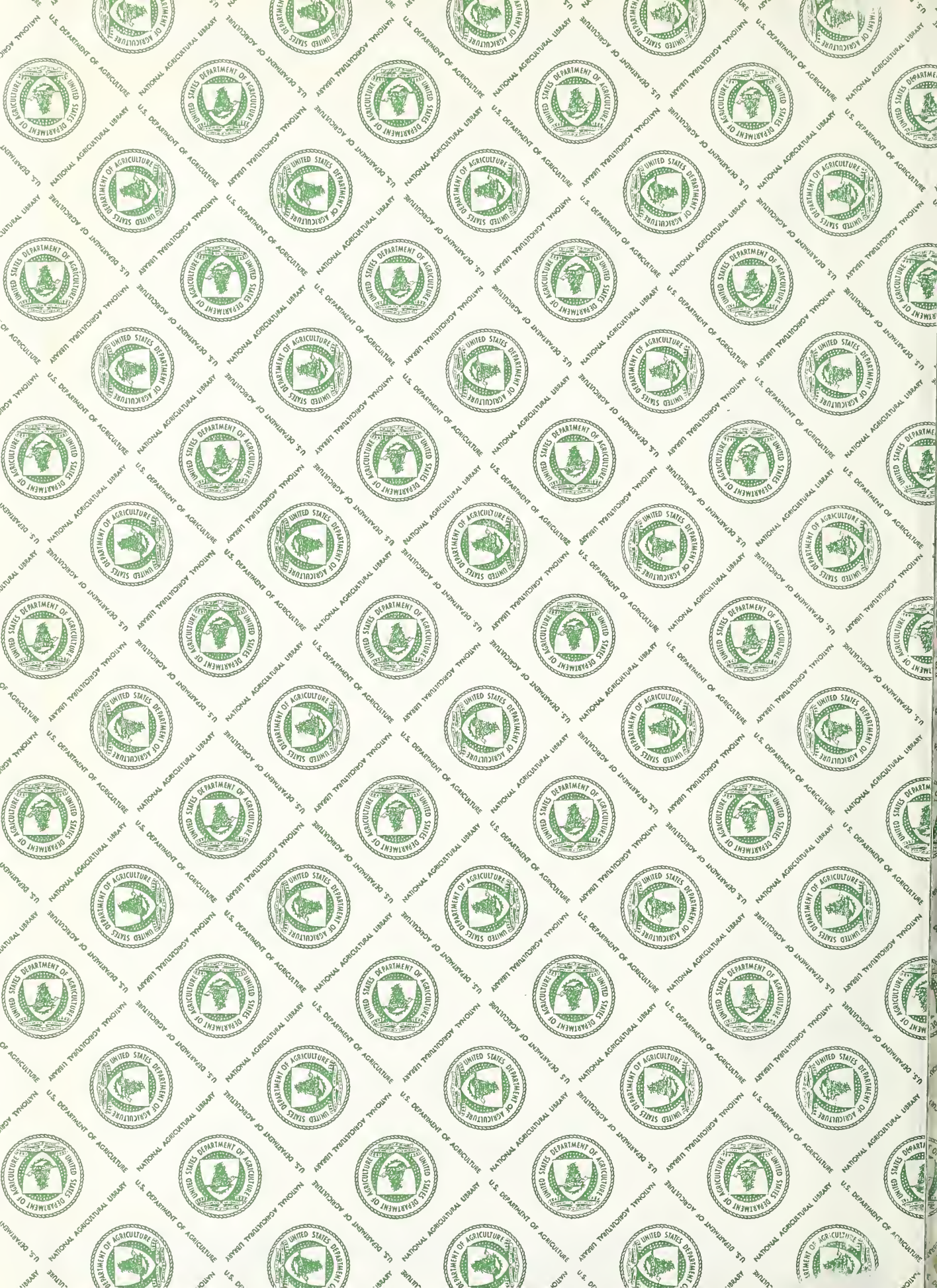
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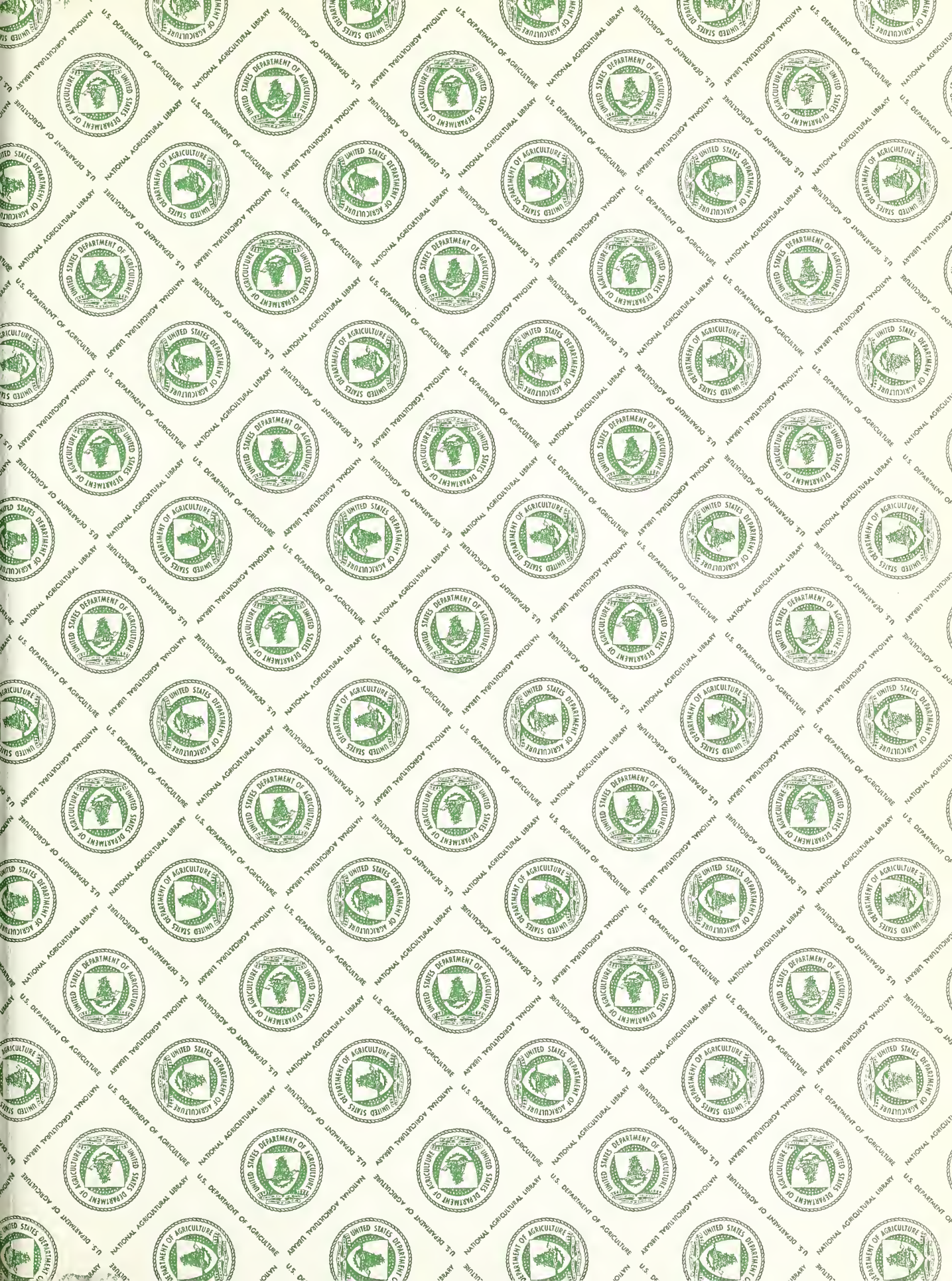
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CHEMICAL, MILLING, AND BAKING EXPERIMENTS WITH HARD RED SPRING WHEATS, 1940 CROP

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UNITED STATES DEPARTMENT OF AGRICULTURE

Bureau of Plant Industry

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Agricultural Marketing Service

CHEMICAL, MILLING, AND BAKING EXPERIMENTS WITH HARD RED SPRING WHEATS 1940 CROP[1/]

by

C. C. Fifield, Associate Baking Technologist, and J. A. Clark, Senior Agronomist, Wheat Investigations, Division of Cereal Crops and Diseases, Bureau of Plant Industry; and Ray Weaver, Assistant Baking Technologist, H. C. Fellows, Associate Grain Technologist, J. F. Hayes, Elwood Hoffecker, B. E. Rothgeb, and Alfred Christie, Assistant Grain Technologists, Grain and Seed Division, Agricultural Marketing Service

CONTENTS

INTRODUCTION

Samples of some of the old standard varieties and new hybrid strains of spring wheat grown in cooperative experiments in the spring wheat region[2/] of the United States are milled each year by the United States Department of Agriculture and the flour baked into bread by a number of different methods to determine their quality characteristics. In addition, a number of commercial wheat samples are analyzed to obtain information relative to the chemical, milling, and baking properties of the wheat grades reaching terminal markets as compared with varietal samples grown in plots at agricultural experiment stations.

1/ Cooperative investigations of the Division of Cereal Crops and Diseases, Bureau of Plant Industry, and the Grain and Seed Division, Agricultural Marketing Service. The experiments were conducted in the laboratories of the Grain and Seed Division, Agricultural Marketing Service.

2/ Clark, J. A. Results of spring wheat varieties grown in cooperative plot and nursery experiments in the spring wheat region in 1940, with averages for 1929 to 1940. 45 pp. [Unnumb. publication] [Mimeographed.] 1941.

The writers wish to express appreciation for the assistance of Mrs. A. Sallak, Clerk, Division of Cereal Crops and Diseases, in tabulating and checking the data and calculating the standard errors.

Tests of a new Buhler mill in comparison with the older type Allis-Chalmers mill have been made during the year also, using the 8 uniform wheat varieties from the western composite, and 8 baking methods. These include the 4 methods used by the laboratory in 1939 and 4 methods for bromate response similar to methods used by the Kansas Regional Laboratory. The purpose of this report is to make available quality data from the 1940 crop obtained from standard varieties, new strains, and Federal supervision grade samples of hard red spring wheat.

SOURCE OF SAMPLES

Chemical, milling, and baking tests have been made on composite samples of each of 8 uniform varieties grown in plots at the eastern and the western stations in the region and from the 26 strains grown in Uniform Regional Nurseries. One other composite was made of plot samples grown at 4 Minnesota stations. In addition, samples from plots grown at St. Paul, Minn.; Brookings, S. Dak.; Fargo, Langdon, Mandan, and Dickinson, N. Dak.; Moccasin and Havre, Mont.; and Sheridan, Wyo.; were tested. The Federal Grain Supervision samples were assembled from car-lots by grade at Minneapolis, Minn.; Great Falls, Mont.; and Spokane, Wash. Eight composite samples from cars of wheat grading No. 3 or better were obtained from field offices of the Grain and Seed Division, Agricultural Marketing Service, representing the better grades of hard red spring wheat received at these markets.

METHODS USED IN THE BAKING TESTS

Baking tests on the 1940 samples were conducted by the straight dough procedure using the same four baking procedures included in testing the 1939 samples, i.e., (No. 1) basic, (No. 2) commercial, (No. 3) commercial-bromate, and (No. 6) commercial-bromate-malted wheat flour, were used for all the varietal samples. Details of the four methods used this year with the various ingredients are shown in table 1.

Table 1. - Baking methods used for samples of the 1940 crop

Ingredients	Baking methods			
	No. 1	No. 2	No. 3	No. 6
	Basic	Commercial	Commercial-bromate	Commercial-bromate-malted wheat flour
Flour (grams)(13.5 percent moisture basis)	100.0	100.0	100.0	100.0
Yeast (grams)	2.0	2.0	2.0	2.0
Salt (grams)	1.5	1.5	1.5	1.5
Sugar (grams)	5.0	5.0	5.0	5.0
Potassium Bromate (grams)			.001	.001
Malted wheat flour (grams)				.25
Dried skimmilk (grams)		4.0	4.0	4.0
Shortening (grams)		3.0	3.0	3.0
Water absorption (percent)	proper	proper	proper	proper
Mixing time (minutes)	proper for each variety	proper for each variety	proper for each variety	proper for each variety
Fermentation time (minutes)	180	180	180	180
Fermentation periods:	1st punch after 105 minutes, and 2nd punch after additional 50 minutes. Mold after additional 25 minutes. Proofing time - 55 minutes. Baked 25 minutes at 230° C.			

The baking procedure used is based on the method of the American Association of Cereal Chemists[3/] with certain modifications deemed necessary for unbleached experimentally milled flour. Because of the size of the mixing bowl, ingredients sufficient for two loaves were mixed at one time. They were mixed a sufficient length of time to properly develope the dough in a Hobart-Swanson dough-mixer (108 R.P.M. with 4 pins in the head and 2 pins in the bowl.) The absorption of the flour was determined by adding the proper amount of water at the time the doughs were mixed. Absorption and mixing time are indicated in the tables. When mixed, the doughs were divided, then rounded in the hands and placed in fermentation graniteware "oatmeal" bowls, measuring 6 inches top diameter, 3 inches bottom diameter, and 2-1/2 inches deep. The punches were made by folding the dough approximately 10 times in the hands. At the end of the fermentation period the dough was molded by a Thompson mechanical roll type "A" moulder with rolls set at a clearance of 3/8 of an inch and the compression plate 1-1/8 inches. The molded doughs were placed in baking pans constructed from 2XX tin known as the tall form. A proofing time of 55 minutes at 86° F and baking time of 25 minutes at 450° F was the same for all the samples. Two loaves of each

3/ 1934 Official American Association of Cereal Chemists. Basic baking test. Cereal Chem. 11: 363-367.

sample were baked but since the ingredients were mixed as for one loaf, the two are not duplicates in the sense in which that term is usually used and are not so considered herein. Data given in the tables are averages of the two loaves.

The basic method (No. 1) has been used on all samples starting with the 1929 crop. In 1935, the commercial method (No. 2) was added and in 1936, the commercial-bromate (No. 3). For a part of the samples in 1937, the basic, commercial, and commercial-bromate bakes were made. In 1938, the same bakes as reported in 1937 were made and in addition the (No. 4) malt-phosphate-bromate. In 1939, the current methods, with No. 6 replacing No. 4, were used. The commercial-bromate-malted wheat flour (No. 6) test was first used for part of the 1938 samples and has been continued for all of the 1939 and 1940 samples. This test seems to reveal the maximum strength of the wheats, shown by the larger loaf volumes. This baking formula makes provision for adequate gas production by the employment of sufficient sugar and diastatic supplements.

In some years, other special methods were used for certain varieties. This year special tests were made on the western composites of the uniform varieties for bromate response, on flours from both the Allis-Chalmers and Buhler mills. These tests are similar to those used by the Kansas Regional Laboratory for hard red winter wheat.

In the following tables, loaf volumes are reported for the four different methods of baking but only averages are given for absorption, weight, crumb color, and grain texture of loaf. The optimum or highest volume for any method, is shown in the tables also, but the varieties are ranked in order of their average volumes for the four different methods. The highest ranking variety with respect to each property is indicated by underlining. Standard errors have been calculated (Interaction: baking method x variety) and a double underline is drawn in each table separating those varieties which are significantly lower than the one having the highest average volume in the test.

All test weights were determined in the laboratory on a dockage-free basis. The protein and ash contents and water absorption are reported on a 13.5 percent moisture basis and the flour yield on a moisture-free basis.

EXPERIMENTAL RESULTS

The results for the composite and station samples are given in tables 2 to 16. The Allis-Chalmers and Buhler mill comparisons are given in tables 17 and 18. The results from the commercial samples are shown in table 19. These tables are largely self-explanatory. Acre yields are included, where comparable, to assist in the interpretation of results.

The test weights for most of the composite and individual station samples were satisfactory. A number of samples of the older standard varieties grown in plots, tested less than 55 pounds due to damage from sten rust. The samples from Dickinson, N. Dak., were damaged by the Says grain bug and those from Moccasin and Havre, Mont., were lower than desired in test weight, due to drought.

Since duplicate determinations were not made in most cases, it is not possible to correctly estimate random errors. Four baking methods were used in nearly all cases and it is possible to calculate errors by considering these as replicate bakes. This has been done and the resulting standard error is indicated in each table.

It should be noted that the error calculated in this way is in reality variety x method interaction, and unless used with caution and discretion may lead to erroneous conclusions. Interaction error is never less (within the limits of sampling error) than the true error but may be much greater, depending on whether varieties respond alike or differently to the different baking methods. Inspection of the data indicates that in some cases not all varieties responded alike to the different baking methods from which it may be inferred that the calculated errors (variety x method interaction) are in excess of the true errors. This is in accord with other studies in this laboratory in which true errors have been calculated and found to be in the neighborhood of 15 to 20 cc for a single determination.

Table 2. - Yields[1] and milling, baking, and chemical results on the uniform varieties of spring wheat grown in plot experiments from (1) eastern and (2) western composites of the 1940 crop

Variety	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption average	Mixing time	Baking method and volume of loaf[2]						Average weight of loaf	Average crumb color	Average grain texture
				Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
		(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Eastern Composite[3]																		
Pilot-B	11428	27.2	58.2	16.2	15.0	69.7	.56	68.0	2.0	823	951	985	1006	1006	941	152	96	90
Ceres	6900	21.3	56.7	15.3	14.4	69.4	.55	72.0	2.5	806	897	908	931	931	886	155	89	88
Renown	11947	28.0	60.1	16.4	15.2	69.6	.54	67.0	2.0	740	865	954	962	962	880	151	89	85
Thatcher	10003	30.2	58.2	15.5	15.1	71.7	.55	68.0	2.0	715	838	928	971	971	863	153	86	86
Premier	11940	30.4	60.8	15.1	14.7	70.7	.58	72.0	2.5	697	853	853	917	917	830	159	95	88
Rival	11708	28.1	59.1	15.6	14.9	71.9	.59	69.0	2.5	657	801	884	960	960	826	153	94	90
Merit	11870	29.5	58.2	15.6	14.9	69.4	.58	73.0	2.5	640	812	882	968	968	826	159	90	85
Marquis	3641	16.6	53.7	14.6	13.6	66.3	.61	63.0	2.0	646	783	826	740	826	749	149	83	86
Average		26.4	58.1	15.5	14.7	69.8	.57	69.0	2.3	716	850	903	932	943	850	154	90	87
Range		13.8	7.1	1.8	1.6	5.6	.07	10.0	0.5	183	168	159	266	180	192	10	12	5
Western Composite[4]																		
Thatcher	10003	12.9	55.8	17.2	16.5	69.6	.58	68.0	2.0	778	896	994	1038	1038	927	152	80	78
Pilot-B	11428	11.2	55.6	17.1	16.0	68.7	.56	68.0	2.0	738	882	962	977	977	890	153	81	76
Marquis	3641	10.9	56.3	16.8	15.8	67.9	.69	63.0	2.0	688	830	960	991	991	867	149	86	85
Ceres	6900	12.4	58.3	16.5	15.6	69.5	.56	67.0	2.0	712	873	936	945	945	867	152	88	84
Renown	11947	10.2	57.2	16.8	16.0	72.3	.64	63.0	2.0	686	786	948	962	962	846	149	81	84
Rival	11708	11.4	56.2	15.9	14.9	70.6	.58	66.0	2.0	655	803	908	976	976	836	152	83	79
Merit	11870	11.3	55.3	16.6	15.4	70.3	.62	72.0	2.5	671	787	902	936	936	824	158	75	75
Premier	11940	12.1	58.0	15.9	15.0	70.1	.58	69.0	2.0	643	764	876	913	913	799	156	81	76
Average		11.6	56.6	16.6	15.7	69.9	.60	67.0	2.1	696	828	936	967	967	857	153	82	80
Range		2.7	3.0	1.3	1.6	4.4	.13	9.0	0.5	135	132	118	125	125	128	9	13	10

1/ Average yields of those stations included in the composite.

2/ Standard errors (Variety x Method interaction) for a single determination = 39.0 cc for the eastern composites and 19.1 cc for the western composites.

3/ Two pounds each from the St. Paul, Waseca, Morris, Crookston, Langdon, Fargo, Brookings, and Lincoln stations. Eight pounds or duplicate millings made in Washington and 4 pounds sent to each of the St. Paul and Fargo laboratories.

4/ Samples included in western region were from Mandan and Dickinson, N. Dak.; Moccasin and Havre, Mont.; Highmore and Eureka, S.Dak.; Alliance, Nebr.; and Sheridan, Wyo.

Table 3. - Average yield, milling, baking, and chemical results on the eastern and western composites of the uniform varieties of spring wheat grown in plot experiments

Variety	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption average	Mixing time	Baking method and volume of loaf 1/						Average weight of loaf	Average crumb color	Average grain texture
				Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
		(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Average of Eastern and Western Composites, 1940																		
Pilot-B	11428	19.2	56.9	16.7	15.5	69.2	.56	68.0	2.0	781	917	974	992	992	916	152	88	83
Thatcher	10003	21.6	57.0	16.4	15.8	70.7	.57	68.0	2.0	747	867	961	1005	1005	895	153	83	82
Ceres	6900	16.9	57.5	15.9	15.0	69.5	.56	69.5	2.3	759	885	922	938	938	877	154	89	86
Renown	11947	19.1	58.7	16.6	15.6	71.0	.59	65.0	2.0	713	826	951	962	962	863	150	85	85
Rival	11708	19.8	57.7	15.8	14.9	71.3	.59	67.5	2.3	656	802	896	968	968	831	153	89	85
Merit	11870	20.4	56.8	16.1	15.2	69.9	.60	72.5	2.5	656	800	892	952	952	825	159	83	80
Premier	11940	21.3	59.4	15.5	14.9	70.4	.58	70.5	2.3	670	809	865	915	915	815	158	88	82
Marquis	3641	13.8	55.0	15.7	14.7	67.1	.65	63.0	2.0	667	807	893	866	908	808	149	85	86
Average		19.0	57.4	16.1	15.2	69.9	.59	68.0	2.2	706	839	919	950	955	854	154	86	84
Range		7.8	4.4	1.2	1.1	4.2	.09	9.5	0.5	125	117	109	139	97	108	10	6	6
Average of 1939 and 1940 composites																		
Pilot-B	11428	20.5	56.7	16.2	15.2	69.8	.56	67.0		778	893	960	970	970	900	151	87	86
Thatcher	10003	21.6	56.5	16.4	15.9	70.7	.55	67.5		761	870	959	991	991	895	152	84	84
Ceres	6900	19.0	57.7	15.8	15.0	70.2	.56	67.8		744	860	901	923	923	857	153	87	88
Renown	11947	19.1	58.1	16.5	15.7	70.6	.58	65.9		711	812	934	965	965	856	151	86	87
Marquis	3641	16.0	55.6	15.7	14.8	68.5	.60	63.7		701	830	889	888	909	827	150	87	88
Rival	11708	20.5	57.3	15.6	14.8	71.5	.60	66.8		688	804	886	929	929	827	152	89	88
Merit	11870	21.1	56.2	16.1	15.1	70.1	.59	70.7		662	789	883	943	943	819	157	83	82
Premier	11940	21.6	59.0	15.4	14.7	71.2	.58	68.8		655	787	847	897	897	797	155	88	85
Average		19.9	57.1	16.0	15.2	70.3	.58	67.3		713	831	907	938	941	847	153	86	86
Range		5.6	3.4	1.1	1.2	3.0	.05	7.0		123	106	113	94	94	103	7	6	6

1/ Standard errors (Variety x Method interaction) for a single determination = 23.7 cc for the eastern and western composites in 1940; and 19.1 cc for the 1939 and 1940 composites.

Table 4. - Yields[1], milling, baking, and chemical results on 10 hard red spring wheats grown in plot experiments, from a composite[2] of 4 Minnesota stations in 1940

Variety	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption average	Mixing time	Baking method and volume of loaf[3]						Average weight of loaf	Average crumb color	Average grain texture
					Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Regent	R.L.975.1	11869	36.3	58.4	15.6	14.5	72.6	.57	65.0	2.0	769	894	942	940	942	886	150	90	89
Pilot-B	1098-B	11428	33.9	58.7	15.1	14.3	71.2	.60	67.0	2.0	749	900	873	891	900	853	151	89	88
Renown	R.L.716.6	11947	36.0	60.7	15.1	14.4	73.4	.55	63.0	2.0	764	847	856	891	891	840	147	90	93
Thatcher	----	10003	38.3	58.4	15.1	14.2	72.1	.57	65.0	2.0	716	888	876	874	888	839	149	90	93
H-44 x Thatcher	II-29-52	11890	36.6	57.8	14.9	14.2	73.3	.55	65.0	2.0	682	896	876	868	896	831	150	86	88
Pilot-13	1098-13	11945	36.2	58.9	14.8	13.9	70.2	.50	65.0	2.0	626	812	841	812	841	773	150	88	91
Merit	1348	11870	36.7	58.6	14.5	14.0	73.6	.57	72.0	2.5	590	764	865	821	865	760	158	86	89
Premier	Ns. 2772	11940	36.8	60.7	14.8	13.6	73.5	.64	70.0	2.5	675	758	823	784	823	760	156	85	88
Rival	Ns. 2634	11708	34.9	59.5	14.9	13.8	73.2	.53	69.0	2.0	620	876	769	770	876	759	156	86	89
C.-D.C. x C.-H.-F.[4]	Ns.2829	12008	39.8	61.3	14.8	13.8	73.8	.57	66.0	2.0	655	785	775	746	785	740	153	90	89
Average			36.6	59.3	15.0	14.1	72.7	.57	66.7	2.1	685	842	850	840	881	804	152	88	90
Range			5.9	3.5	1.1	0.9	3.6	.14	9.0	0.5	179	142	173	194	157	146	11	5	5

1/ Average yield of those stations included in the composite.
2/ One pound from each of the St. Paul, Waseca, Morris, and Crookston stations.
3/ Standard error (Variety x Method interaction) for a single determination = 34.0 cc.
4/ Ceres-Double Cross x Ceres-Hope-Florence.

Table 5. - Yield, milling, baking, and chemical results obtained on 12 hard red spring wheats grown in plot experiments at University Farm, St. Paul, Minn., in 1940

Variety	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption	Mixing time	Baking method and volume of loaf[1]						Average weight of loaf	Average crumb color	Average grain texture
					Wheat	Flour	Yield	Ash	average		No.1	No.2	No.3	No.6	Optimum	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Regent	R.L.975.1	11869	39.8	56.5	13.7	12.9	70.9	.68	69.0	2.0	709	894	838	841	894	821	153	90	80
Renown	R.L.716.6	11947	44.0	60.0	14.6	13.6	71.7	.61	68.0	2.0	721	859	844	850	859	819	153	85	86
Pilot-B	1098-B	11428	39.3	57.8	13.4	12.3	70.8	.63	66.0	2.0	640	815	800	787	815	761	154	83	84
Premier	Ns. 2772	11940	41.8	59.9	13.4	12.4	72.6	.72	69.0	2.5	646	792	797	798	798	758	156	88	78
Rival	Ns. 2634	11708	40.7	58.1	13.8	12.8	73.2	.70	71.0	2.5	585	821	770	772	821	737	157	90	86
Thatcher	----	10003	42.3	57.3	13.2	12.3	71.6	.62	65.0	2.0	611	733	781	807	807	733	154	86	90
Merit	1348	11870	40.4	57.1	13.9	12.5	71.4	.63	72.0	2.5	562	748	749	841	841	725	159	89	84
Pilot-13	1098-13	11945	41.3	58.0	13.9	11.2	70.5	.62	66.0	2.0	590	770	703	789	789	713	153	88	90
C.-D.C. x C.H.F.[2]	Ns.2829	12008	48.3	60.4	13.4	11.9	73.2	.61	67.0	2.0	611	752	709	718	752	698	153	91	85
H-44 x T.[3]	IL-29-52	11890	41.3	56.0	14.3	13.0	71.0	.71	66.0	2.0	582	764	703	715	764	691	153	86	81
Marquis	----	3641	21.0	54.2	11.4	10.5	63.5	.61	63.0	2.0	556	677	674	755	755	666	151	84	84
Ceres	----	6900	29.1	56.2	12.2	10.9	66.4	.53	63.0	2.0	556	650	655	685	685	637	150	80	80
Average			39.1	57.6	13.4	12.2	70.6	.64	67.1	2.1	614	773	752	780	798	730	154	87	84
Range			27.3	6.2	3.2	3.1	9.7	.19	9.0	0.5	165	244	189	165	209	184	9	11	12

1/ Standard error (Variety x Method interaction) for a single determination = 29.2 cc.
2/ Ceres-Double Cross x Ceres-Hope-Florence.
3/ H-44 x Thatcher.

Table 6. - Yield, milling, baking, and chemical results obtained on 15 hard red spring wheats grown in plot experiments at Brookings, S. Dak., 1940

Variety	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Mixing time	Water absorption average	Baking method and volume of loaf 1/						Average weight of loaf	Average crumb color	Average grain texture
					Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Thatcher	-----	10003	35.4	56.5	16.2	15.5	70.5	.54	2.0	65.0	792	902	923	985	985	901	149	80	89
Renown	R.L.716.6	11947	35.2	58.1	16.5	15.6	71.3	.54	2.0	67.0	716	841	925	985	985	868	153	81	83
Regent	R.L.975.1	11869	35.4	53.4	16.9	16.4	70.3	.62	2.0	66.0	685	829	943	994	994	863	151	76	76
Pilot-B	1098-B	11428	33.8	55.4	16.3	15.2	69.5	.60	2.0	65.0	677	838	931	982	982	857	151	73	81
Pilot-13	1098-13	11945	35.3	56.7	16.5	15.2	68.4	.52	2.5	65.0	700	859	913	951	951	856	151	81	86
Rival	Ns. 2634	11708	35.2	56.3	16.2	14.9	72.7	.57	2.5	66.0	697	832	902	897	902	832	152	80	85
H-R x R 2/	S.D. 1465	12033	34.4	58.5	14.9	14.0	71.5	.54	2.5	65.0	612	862	874	894	894	811	148	84	88
Marquis	-----	3641	17.1	46.7	14.4	13.7	60.4	.56	2.0	63.0	735	821	853	836	853	811	150	70	86
Triumpho	-----	-----	----	58.1	14.1	12.6	71.9	.52	1.5	61.0	643	772	893	925	925	808	147	81	78
Hope x Ceres	S.D.1463	11897	32.4	58.0	15.9	14.9	70.4	.60	2.5	67.0	629	816	850	922	922	804	152	81	83
H-R x R 2/	S.D.1464	12009	33.4	60.1	15.9	14.3	70.5	.53	2.5	66.0	612	879	804	847	847	786	151	83	86
Ceres	-----	6900	23.1	53.0	14.4	14.0	66.7	.55	2.5	66.0	657	826	804	847	847	784	153	70	85
Merit	1348	11870	37.7	55.7	15.8	14.8	73.2	.70	2.5	71.0	599	755	835	931	931	780	155	75	76
H-44 x Thatcher	UI-29-52	11890	40.3	55.0	16.0	14.8	73.1	.57	2.0	63.0	596	755	850	888	888	772	150	79	78
Premier	Ns. 2772	11940	40.2	60.2	15.0	13.8	73.8	.64	2.0	67.0	565	691	769	839	839	714	156	76	73
Average			(33.5)	56.1	15.7	14.6	70.3	.57	2.2	65.5	661	819	871	914	918	816	151	78	82
Range			(23.2)	13.5	2.8	3.8	13.4	.18	1.0	10.0	227	211	174	165	165	187	9	14	16

1/ Standard error (Variety x Method interaction) for a single determination = 36.4 cc.
2/ Hope-Reliance x Reliance.

Table 7. - Yield, milling, baking, and chemical results obtained on 14 hard red spring wheats grown in plot experiments at Fargo, N. Dak., 1940

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption average	Mixing time	Baking method and volume of loaf[1]						Average weight of loaf	Average crumb color	Average grain texture
					Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Pilot-B	1098-B	11428	16.1	58.7	17.2	16.8	70.7	.54	67.0	2.0	838	908	911	922	922	895	151	85	89
Pilot-13	1098-13	11945	17.2	58.2	16.9	16.2	71.0	.48	70.0	2.5	786	919	896	853	919	864	152	81	85
Ceres	----	6900	17.5	60.5	16.6	16.2	72.5	.52	73.0	2.5	710	835	853	844	853	811	156	81	88
Merit	1348	11870	18.4	59.3	16.5	16.0	72.0	.58	71.0	2.0	672	829	847	831	847	795	155	83	91
Renown	R.L.716.6	11947	17.6	60.8	15.9	15.5	72.2	.47	63.0	2.0	666	800	835	879	879	795	149	84	88
Thatcher	----	10003	19.4	58.3	15.9	15.4	71.0	.51	65.0	2.0	666	809	826	835	835	784	150	81	90
R-H x C-1121[2]	1520	12050	17.5	60.0	16.9	16.1	72.0	.45	65.0	2.0	680	798	847	810	847	784	150	86	95
C-DC x CHF[3]	Ns.2829	12008	19.7	60.8	15.8	15.2	73.3	.52	67.0	2.0	660	786	841	838	841	781	150	89	90
Rival	Ns. 2634	11708	18.0	60.0	16.2	15.6	72.3	.58	69.0	2.5	672	829	786	812	829	775	154	85	89
H-44 x Ceres	1349-15	12010	18.2	59.8	16.5	16.2	70.3	.60	75.0	2.5	660	804	838	786	838	772	159	76	90
M[2] x C-1018[4]	Ns. 2822	12071	21.2	59.1	16.0	15.3	73.2	.48	70.0	2.0	629	764	818	841	841	763	154	86	91
Marquis	----	3641	14.7	58.7	15.2	14.4	70.2	.53	67.0	2.0	635	781	786	758	786	740	153	88	91
Premier	Ns. 2772	11940	20.4	60.9	15.5	14.7	72.6	.50	66.0	2.0	624	732	726	758	758	710	152	86	91
Hope x Supreme	1543	12038	18.7	60.0	15.1	14.3	73.2	.48	67.0	2.0	562	732	760	784	784	710	154	79	88
Average			18.2	59.7	16.2	15.6	71.9	.52	68.2	2.1	676	809	826	825	841	784	153	84	90
Range			6.5	2.7	2.1	2.5	3.1	.15	12.0	0.5	276	187	185	164	164	185	10	13	10

1/ Standard error (Variety x Method interaction) for a single determination = 25.0 cc.
2/ Reliance-Hope x Comet-N.No. 1121.
3/ Ceres-Double Cross x Ceres-Hope-Florence.
4/ Mercury[2] x Comet-N.No. 1018.

Table 8. - Yield, milling, baking, and chemical results obtained on 11 hard red spring wheats grown in plot experiments at Langdon, N. Dak., 1940

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption average	Mixing time	Baking method and volume of loaf 1/						Average weight of loaf	Average crumb color	Average grain texture
					Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Pilot-13	1098-13	11945	26.6	60.2	16.1	14.9	70.4	.48	72.0	2.0	818	931	960	954	960	916	156	89	84
Thatcher	----	10003	25.9	59.1	15.2	14.6	70.7	.50	69.0	2.0	746	874	939	977	977	884	153	83	89
H-44 x Thatcher	II-29-52	11890	22.3	59.0	15.9	14.6	72.3	.54	67.0	2.0	732	865	879	914	914	848	152	80	89
Pilot-B	1098-B	11428	25.7	59.8	15.9	15.2	69.4	.48	67.0	2.0	784	838	900	856	900	845	152	88	86
Merit	1348	11870	27.0	59.5	15.2	14.3	69.5	.57	75.0	2.5	720	856	920	838	920	836	159	90	91
Vesta	Ns. 2592	11712	23.1	61.4	15.2	14.3	74.5	.52	69.0	2.0	686	830	885	920	920	830	155	86	86
C-DC x CHF 2/	Ns. 2829	12008	27.6	61.7	15.6	15.1	73.0	.53	68.0	2.0	700	850	847	909	909	827	154	80	88
Regent	R.L.975.1	11869	24.4	58.7	15.9	15.9	70.7	.50	68.0	2.0	626	844	905	905	905	820	155	80	84
Rival	Ns. 2634	11708	24.5	60.7	14.9	14.2	72.4	.53	74.0	2.5	675	801	873	908	908	814	159	86	88
C-1110 x H 3/	1512	12057	21.2	60.3	15.9	15.2	71.2	.57	70.0	2.0	651	835	818	835	835	785	155	76	83
Premier	Ns. 2772	11940	28.2	61.6	16.0	15.0	70.5	.55	72.0	2.5	643	826	812	807	826	772	159	90	88
Average			25.1	60.2	15.6	14.8	71.3	.52	70.1	2.1	707	850	885	893	907	833	155	84	87
Range			7.0	3.0	1.2	1.7	5.1	.09	8.0	0.5	192	130	148	170	151	144	7	14	8

1/ Standard error (Variety x Method interaction) for a single determination = 32.1 cc.
2/ Ceres-Double Cross x Ceres-Hope-Florence.
3/ Comet-N.No. 1110 x H-44-Ceres.

Table 9. - Yield, milling, baking, and chemical results obtained on 16 hard red spring wheats grown in plot experiments at Mandan, North Dakota, 1940

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption average	Mixing time	Baking method and volume of loaf[1]						Average weight of loaf	Average crumb color	Average grain texture
					Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Thatcher	----	10003	13.7	55.1	17.7	16.8	68.1	.48	70.0	2.5	724	856	940	911	940	858	157	81	89
Rival	Ns. 2634	11708	15.1	58.7	15.2	14.9	70.8	.53	69.0	2.5	617	764	795	850	850	757	157	80	91
Pilot-B	1098-B	11428	15.3	57.7	15.4	14.7	69.2	.50	66.0	2.0	605	786	798	797	798	747	154	83	89
C-DC x CHF[2]	Ns. 2809	12007	14.4	59.5	16.1	15.1	72.0	.57	70.0	2.0	614	772	850	746	850	746	156	86	90
M[2] X C-1018[3]	Ns. 2822	12071	14.9	58.4	14.6	13.8	72.4	.53	71.0	2.5	562	707	755	792	792	704	159	84	85
Hope x Supreme	1543	12038	15.7	58.6	14.2	13.6	70.7	.44	68.0	2.0	558	707	755	766	766	697	158	78	84
H-44 x Ceres	1342-24	12048	16.2	59.8	14.5	13.3	69.3	.49	75.0	3.0	605	712	692	738	738	687	162	74	83
Pilot-13	1098-13	11945	12.5	59.0	13.2	12.6	69.5	.50	66.0	2.0	585	689	706	762	762	686	155	76	86
Hope x Reward	1546	12075	13.2	61.1	13.8	13.0	71.3	.59	67.0	2.0	553	692	724	712	724	670	158	76	80
C-DC x CHF[2]	Ns. 2829	12008	16.4	61.8	13.8	13.1	71.4	.52	69.0	2.0	568	691	683	694	694	659	157	85	88
Hope x H.F.[4]	1268	11798	17.3	58.3	13.9	13.2	69.8	.38	69.0	2.0	556	694	660	684	694	649	159	75	80
R-H x H-C[5]	1525	12047	14.1	61.7	13.5	12.7	72.0	.58	68.0	2.0	526	643	683	726	726	645	158	78	80
Merit	1348	11870	13.9	58.2	13.8	12.9	70.2	.52	71.0	3.0	520	655	657	727	727	640	160	79	80
R-H x C-1121[6]	1516	12076	12.7	60.1	13.1	12.5	71.9	.50	65.0	2.0	517	654	660	703	703	634	156	74	79
H-44 x Ceres	1349-15	12010	14.0	58.9	14.0	13.3	69.6	.56	74.0	3.0	503	632	620	660	660	604	163	75	74
Premier	Ns. 2772	11940	14.5	61.9	13.8	13.1	70.9	.51	71.0	2.5	509	629	611	608	629	589	161	81	76
Average			14.6	59.3	14.4	13.7	70.6	.51	69.6	2.3	570	705	724	742	753	685	158	79	83
Range			4.8	6.8	4.6	4.3	4.3	.21	10.0	1.0	221	227	329	303	311	269	9	12	15

1/ Standard error (Variety x Method interaction) for a single determination = 26.7 cc.
2/ Ceres-Double Cross x Ceres-Hope-Florence.
3/ Mercury[2] x Comet-N.No. 1018.
4/ Hope x Hard Federation.
5/ Reliance-Hope x H-44-Ceres.
6/ Reliance-Hope x Comet-N.No. 1121.

Table 10. - Yield, milling, baking, and chemical results obtained on 13 hard red spring wheats grown in plot experiments at Dickinson, N. Dak., 1940

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption average	Mixing time	Baking method and volume of loaf[1]						Average weight of loaf	Average crumb color	Average grain texture
					Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Thatcher	----	10003	8.2	57.6	15.6	15.0	70.5	.43	67.0	2.0	629	809	902	948	948	822	153	85	83
Pilot-13	1098-13	11945	6.3	56.3	15.5	14.4	66.3	.40	65.0	2.0	617	775	852	902	902	787	153	85	86
Hope x H.F.[2]	1268	11798	8.1	56.2	14.9	14.5	68.7	.41	68.0	2.0	544	718	789	868	868	730	157	86	79
M[2] x C-1018[3]	Ns. 2822	12071	7.9	57.6	15.6	14.5	70.4	.38	70.0	2.0	562	694	737	815	815	702	160	88	84
R-R x H-C[4]	1528	12051	4.5	55.6	15.8	14.8	66.4	.47	71.0	2.5	573	686	755	778	778	698	159	76	75
C x H-R[5]	1534	12039	8.3	57.0	15.2	14.3	66.3	.38	73.0	2.5	576	692	755	755	755	695	160	83	81
Merit	1348	11870	5.4	53.7	15.5	14.5	64.1	.45	68.0	2.0	535	680	740	772	772	682	158	76	75
Ceres	----	6900	6.4	53.7	16.4	15.9	62.0	.48	63.0	1.5	576	669	683	767	767	674	153	63	65
Pilot-B	1098-B	11428	3.7	55.7	15.8	14.8	65.4	.45	65.0	2.0	553	683	721	727	727	671	156	73	78
C-DC x CHF[6]	Ns. 2829	12008	6.3	58.1	14.7	13.7	68.2	.35	63.0	2.0	506	632	668	740	740	637	155	83	78
Rival	Ns. 2634	11708	5.9	48.5	15.1	13.9	54.5	.55	63.0	1.5	459	567	570	590	590	547	157	47	45
Ceres x Pilot	1552	12077	2.7	52.2	15.8	14.7	59.1	.42	63.0	2.0	431	497	506	547	547	495	157	50	48
Premier	Ns. 2772	11940	8.4	48.3	15.5	13.6	54.9	.56	63.0	1.5	359	443	439	486	486	432	158	35	33
Average			6.3	54.7	15.5	14.5	64.4	.44	66.3	2.0	532	657	701	746	746	659	157	72	70
Range			5.7	9.8	1.7	2.3	16.0	.21	10.0	1.0	198	366	463	462	462	366	7	53	53

1/ Standard error (Variety x Method interaction) for a single determination = 33.3 cc.
2/ Hope x Hard Federation.
3/ Mercury[2] x Comet-N.No. 1018.
4/ Reliance-Reward x H-44-Ceres.
5/ Ceres x Hope-Ridit.
6/ Ceres-Double Cross x Ceres-Hope-Florence.

Table 11. - Yield, milling, baking, and chemical results obtained on 6 hard red spring wheats grown in plot experiments at Moccasin, Mont., 1940

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption average	Mixing time	Baking method and volume of loaf 1/						Average weight of loaf	Average crumb color	Average grain texture
					Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Pilot-13	1098-13	11945	13.6	54.5	17.7	17.6	66.8	.47	68.0	2.5	691	885	1003	1064	1064	911	154	85	83
Pilot-B	1098-B	11428	12.1	54.6	18.2	18.0	67.2	.43	66.0	2.0	652	801	936	965	965	839	154	81	80
Thatcher	-----	10003	15.3	54.3	16.9	16.8	67.5	.42	67.0	2.0	648	798	923	985	985	839	154	81	85
Comet x N.No. 1110	1466	11931	11.3	58.8	16.8	16.9	70.4	.48	70.0	2.5	632	778	934	945	945	822	154	83	84
Merit	1348	11870	14.0	56.1	16.6	16.5	69.4	.44	74.0	2.5	617	766	885	931	931	800	160	80	79
H44 x Thatcher	II-29-52	11890	12.7	55.3	16.6	16.3	70.0	.45	69.0	2.5	623	755	874	902	902	789	155	85	88
Average			13.2	55.6	17.1	17.0	68.6	.45	69.0	2.3	644	797	926	965	965	833	155	83	83
Range			4.0	4.5	1.6	1.7	3.6	.06	8.0	0.5	74	130	129	162	162	122	6	5	9

1/ Standard error (Variety x Method interaction) for a single determination = 15.1 cc.

Table 12. - Yield, milling, baking, and chemical results obtained on 6 hard red spring wheats grown in plot experiments at Havre, Mont., 1940

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption average	Mixing time	Baking method and volume of loaf 1/						Average weight of loaf	Average crumb color	Average grain texture
					Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Thatcher	-----	10003	12.5	55.0	17.7	17.7	71.3	.52	2.5	67.0	766	885	1006	1047	1047	926	150	90	85
Pilot-B	1098-B	11428	10.8	56.0	17.6	17.1	69.5	.66	2.0	66.0	724	827	957	1000	1000	877	151	81	81
Regent	R.L.975.1	11869	11.1	54.4	17.5	16.9	70.6	.71	2.0	65.0	686	778	925	988	988	844	151	81	79
Apex	-----	11636	11.7	65.6	17.4	16.7	68.9	.59	2.0	65.0	657	761	908	997	997	831	152	81	78
1131 x Pilot	1441	11948	8.0	57.2	17.1	15.9	70.4	.55	2.0	65.0	635	795	882	928	928	810	151	79	79
Merit	1348	11870	9.7	54.3	17.2	16.3	71.4	.67	2.5	68.0	620	772	890	923	923	801	154	81	79
Average			10.6	57.1	17.4	16.8	70.4	.62	2.2	66.0	681	803	928	981	981	848	152	82	89
Range			4.5	11.3	0.6	1.8	2.5	.19	0.5	3.0	146	124	124	124	124	125	4	11	7

1/ Standard error (Variety x Method interaction) for a single determination = 18.0 cc.

Table 13. - Yield, milling, baking, and chemical results obtained on 10 hard red spring wheats grown in plot experiments at Sheridan, Wyo., 1940

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Mixing time	Water absorption average	Baking method and volume of loaf[1]						Average weight of loaf	Average crumb color	Average grain texture
					Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Thatcher	-----	10003	24.8	56.2	18.2	17.4	69.7	.52	2.0	66.0	868	911	1012	982	1012	943	151	80	85
Pilot-13	1098-13	11945	23.2	55.3	17.6	16.8	69.2	.54	2.0	65.0	809	900	976	1018	1018	926	149	75	85
Marquis	-----	3641	22.6	58.0	17.2	16.1	69.5	.55	2.0	65.0	781	890	979	951	979	900	149	81	88
Pilot-B	1098-B	11428	24.2	56.6	17.0	16.0	69.9	.52	2.0	65.0	780	891	905	965	965	885	151	75	90
Merit	1348	11870	22.9	56.4	17.2	16.5	72.0	.63	2.0	70.0	720	820	925	1009	1009	869	156	73	74
C-DC x CHF[2]	Ns. 2829	12008	24.1	60.8	16.4	15.5	73.2	.48	2.0	63.0	741	838	824	922	922	831	148	85	91
H-44 x Ceres	1349-15	12010	24.5	58.1	17.0	16.3	68.7	.63	2.0	70.0	669	832	870	948	948	830	154	81	75
Comet	-----	11465	27.8	57.6	16.6	15.2	70.5	.45	2.5	67.0	646	778	850	908	908	796	154	74	83
Re-H x C-1121[3]	1520	12050	22.9	58.7	17.2	15.8	70.3	.50	2.0	63.0	694	786	780	859	859	780	150	75	83
C-1110 x H-C[4]	1512	12057	23.5	58.9	16.1	15.0	71.1	.49	2.0	67.0	629	775	770	841	841	754	153	73	78
Average			24.1	57.7	17.1	16.1	70.4	.53	2.1	66.1	734	842	889	940	946	851	152	77	83
Range			5.2	5.5	2.1	2.4	4.5	.18	0.5	7.0	239	136	242	177	177	189	8	12	17

1/ Standard error (Variety x Method interaction) for a single determination = 32.0 cc.
2/ Ceres-Double Cross x Ceres-Hope-Florence.
3/ Reliance-Hope x Comet-N.No. 1121.
4/ Comet-N.No. 1110 x H-44-Ceres.

Table 14. - Yield, milling, baking, and chemical results on 26 wheats grown in the Uniform Regional Nursery for the eastern composite[1] from 8 stations, 1940

Variety or cross	C.I. number	Acre yield	Test weight	Protein content		Flour			Mixing time	Water absorption average	Baking method and volume of loaf[2]						Average weight of loaf	Average crumb color	Average grain texture
				Wheat	Flour	Yield	Ash	Carotenoid content			No.1	No.2	No.3	No.6	Optimum	Average			
		(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(P.p.m.)	(Min.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Pilot-13	11945	34.1	58.2	15.7	15.2	68.8	.46	1.90	2.0	67.0	873	965	937	928	965	926	150	85	85
Regent	11869	33.3	58.3	16.0	15.9	72.0	.52	2.01	2.0	66.0	838	909	922	988	988	914	149	84	91
Reliance x Hope	11934	29.2	58.1	16.4	16.7	71.7	.57	2.13	2.0	65.0	786	928	905	963	963	896	147	81	83
Thatcher	10003	34.8	58.7	15.5	14.7	71.3	.46	2.35	2.0	67.0	832	914	891	939	939	894	150	85	89
Hope x Thatcher[3]	12044	36.3	58.7	16.2	15.5	74.2	.60	2.35	2.0	67.0	815	911	885	937	937	887	150	85	90
Marquis[2] x H-44	12012	32.4	58.8	15.6	15.8	71.0	.55	1.79	2.0	67.0	784	922	873	936	936	879	152	84	91
Hope x Thatcher[3]	12043	34.3	59.1	16.3	15.6	72.6	.55	2.13	2.5	70.0	841	913	862	893	913	877	154	85	90
H-44 x Thatcher[3]	12041	35.1	58.4	15.8	15.1	70.9	.54	2.24	2.0	67.0	801	894	894	905	905	874	150	80	90
C.D.C. x C.H.F.[3]	12007	34.1	60.0	17.2	16.0	70.9	.50	1.56	2.5	71.0	814	885	867	914	914	870	153	91	91
Hope x Supreme	12038	32.8	58.1	15.6	15.3	71.8	.67	2.35	2.5	71.0	778	862	879	905	905	856	155	80	89
Comet x Reliance-Hope	12049	33.5	59.8	15.8	14.4	73.9	.49	2.01	2.0	63.0	769	876	888	891	891	856	146	80	90
Comet-1121 x CHF[4]	12047	33.9	59.3	16.0	15.4	72.8	.59	2.01	2.0	65.0	723	853	902	945	945	856	148	89	90
H-44 x Marquis	12042	33.9	59.8	15.4	15.2	70.9	.53	2.01	2.5	71.0	778	841	891	890	891	850	154	89	93
C-DC x C.H.F.[3]	12008	36.0	61.2	15.7	14.8	72.9	.50	1.34	2.0	68.0	775	879	847	882	882	846	152	90	86
Merit x Thatcher	12037	35.0	58.1	15.4	15.4	71.7	.63	1.79	2.5	72.0	721	862	873	905	905	840	155	90	88
H-44 x Thatcher	12040	34.5	60.0	15.5	15.0	72.6	.65	2.01	2.0	69.0	781	888	841	847	888	839	153	89	86
H-44 x Ceres	12010	34.6	58.6	16.2	16.7	71.7	.66	1.68	2.5	73.0	691	835	870	911	911	827	154	80	84
Merit-3	12036	37.7	58.0	15.6	15.1	71.9	.52	2.01	3.0	75.0	680	824	862	928	928	824	158	81	84
Hope x Ceres	12058	33.1	59.8	15.5	14.6	71.7	.57	1.90	2.0	63.0	743	844	818	876	876	820	148	90	93
Mercury[2] x Comet-1018	12046	37.6	59.6	15.0	14.0	72.9	.56	1.90	2.0	68.0	732	838	801	815	838	797	152	81	84
C-DC x C.H.F.[3]	12005	34.5	58.1	14.8	14.3	73.1	.52	1.97	2.0	67.0	678	818	795	847	847	785	152	81	84
Rel.-Hope x Reward	12059	31.1	62.2	15.6	14.9	71.7	.61	2.35	2.0	63.0	721	831	758	812	831	781	147	79	81
Ceres x Hope-Ridit	12039	33.4	59.2	14.7	14.2	70.6	.56	2.35	2.5	72.0	718	829	772	800	829	780	155	83	90
Mercury[2] x Comet-1018	12045	35.3	58.7	14.9	14.1	74.3	.56	2.01	2.0	67.0	654	778	809	859	859	775	153	81	84
H-44 x Ceres	12048	37.2	61.2	15.5	15.8	73.3	.68	1.90	2.5	71.0	657	823	792	812	823	771	153	79	85
Marquis	3641	19.1	53.9	13.9	13.4	65.9	.47	2.47	2.0	65.0	626	737	746	813	813	731	151	76	81
Average		33.7	59.0	15.6	15.1	71.8	.56	2.02	2.3	68.1	754	864	853	890	897	840	152	84	87
Range		14.6	8.3	3.3	3.3	8.4	.22	1.13	1.0	12.0	247	228	191	188	175	195	12	15	12

1/ Samples included in the eastern region were from Madison, Wis.; Kanawha, Iowa; Brookings, S. Dak.; St. Paul, Waseca, Morris, and Crookston, Minn.; and Fargo and Langdon, N. Dak.

2/ Standard error (Variety x Method interaction) for a single determination = 27.5 cc.

3/ Ceres-Double Cross x Ceres-Hope-Florence.

4/ Comet-N.No. 1121 x Ceres-Hope-Florence.

Table 15. - Yield, milling, baking, and chemical results on 26 wheats grown in the Uniform Regional Nursery for the western composite[1] from 4 stations, 1940

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Mixing time	Water absorption average	Baking method and volume of loaf[2]						Average weight of loaf	Average crumb color	Average grain texture
					Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Marquis[2] x H-44	R.L.1333	12012	17.2	55.6	16.7	16.2	68.5	.62	2.0	65.0	710	876	1009	1021	1021	904	151	88	83
Pilot-13	1098-13	11945	18.3	56.3	17.3	15.9	69.8	.50	2.0	65.0	727	882	942	1006	1006	889	150	89	86
Thatcher	-----	10003	19.4	55.8	17.2	16.2	70.7	.46	2.0	63.0	746	832	925	988	988	873	149	89	89
H-44 x Thatcher	II-29-72	12041	15.7	55.2	17.2	16.1	69.6	.49	2.0	66.0	703	835	948	974	974	865	151	80	83
Marquis	----	3641	17.4	57.7	16.6	15.6	69.7	.53	2.0	63.0	752	832	920	951	951	864	149	93	85
H-44 x Thatcher	II-29-57	12040	14.8	57.0	16.5	15.6	72.5	.52	2.0	66.0	727	867	856	942	942	848	151	88	83
Merit x Thatcher	1530	12037	18.9	55.1	17.3	16.1	69.2	.51	2.5	70.0	666	815	925	983	983	847	157	85	80
Hope x Thatcher[3]	II-31-34	12044	17.3	55.5	16.9	16.1	72.1	.56	2.0	67.0	685	795	911	972	972	841	152	74	78
Regent	R.L.975.1	11869	17.7	55.9	17.0	16.3	71.3	.61	2.0	65.0	675	789	922	954	954	835	153	84	80
Hope x Thatcher[3]	II-31-6	12043	16.1	55.5	17.4	16.6	72.3	.58	2.0	67.0	669	789	922	954	954	834	154	81	84
Rel.-Hope x Reward	SD 1464.14	12059	15.7	60.5	16.2	15.3	70.7	.74	2.0	65.0	726	841	833	894	894	825	149	81	83
C-DC x CHF[3]	Ns.2809	12007	15.8	57.7	17.9	16.5	70.8	.53	2.0	67.0	686	800	894	900	900	820	153	94	89
H-44 x Marquis	I-38-3	12042	16.0	57.1	16.6	15.5	72.0	.53	2.0	66.0	640	795	888	948	948	818	152	89	85
Comet-1121 x CHF[4]	1523	12047	16.5	57.3	16.9	15.7	71.0	.61	2.0	65.0	626	775	914	948	948	816	151	83	80
Hope x Supreme	1543	12038	18.3	56.7	16.9	15.6	72.1	.54	2.0	66.0	646	758	908	917	917	807	153	76	78
Hope x Ceres	SD 1463.26	12058	17.9	57.5	16.8	15.4	70.7	.71	2.0	65.0	652	806	868	885	885	803	151	86	84
Merit-3	1348-3	12036	19.9	55.5	16.8	15.9	73.1	.54	2.0	68.0	605	755	905	945	945	803	156	73	76
Ceres x Hope-Ridit	1534	12039	18.5	58.0	16.1	15.3	70.4	.52	2.0	69.0	641	783	865	902	902	798	155	79	81
C-DC x CHF[3]	Ns.2829	12008	19.3	59.0	17.2	15.3	71.2	.50	2.0	65.0	626	786	862	888	888	791	151	88	85
H-44 x Ceres	1349-15	12010	17.4	56.6	17.4	16.2	71.4	.67	2.5	71.0	629	732	896	883	896	785	155	76	71
Comet x Reliance-Hope	1568	12049	17.8	58.3	16.6	15.6	72.8	.48	2.0	63.0	629	732	862	908	908	783	148	81	81
C-DC x CHF[3]	Ns.2797	12005	18.1	55.9	16.5	15.5	72.2	.49	2.0	65.0	593	758	876	868	876	774	152	79	80
Mercury[2] x Comet-1018	Ns.2901	12046	18.2	57.0	16.1	14.5	72.5	.71	2.0	66.0	599	772	823	859	859	763	152	80	80
Reliance x Hope	1139-22	11934	13.4	56.4	17.6	16.6	71.5	.63	2.0	63.0	626	761	807	853	853	762	149	74	79
H-44 x Ceres	1342-24	12048	17.7	57.3	16.3	15.6	71.4	.75	2.0	69.0	616	737	795	841	841	747	155	68	71
Mercury[2] x Comet-1018	Ns.2871	12045	19.2	56.1	15.3	14.4	72.5	.53	2.0	67.0	565	712	826	865	865	742	155	75	76
Average			17.4	56.8	16.8	15.8	71.2	.57	2.0	66.0	660	793	889	925	926	817	152	82	81
Range			6.5	1.7	2.6	2.2	4.6	.28	0.5	8.0	187	170	202	180	180	162	9	26	18

1/ Samples included in the western region were from Mandan and Dickinson, N. Dak.; and Moccasin and Havre, Mont.
2/ Standard error (Variety x Method interaction) for a single determination = 26.7 cc.
3/ Ceres-Double Cross x Ceres-Hope-Florence.
4/ Comet-N.No. 1121 x Ceres-Hope-Florence.

Table 16. - Average yield, milling, baking, and chemical results on 26 wheats grown in the Uniform Regional Nurseries for the eastern and western composites in 1940

Variety or cross	C.I. number	Acre yield	Test weight	Protein content		Flour		Mixing time	Water absorption average	Baking method and volume of loaf[1]						Average weight of loaf	Average crumb color	Average grain texture
				Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Optimum	Average			
		(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Pilot-13	11945	26.2	57.3	16.5	15.6	69.3	.48	2.0	66.0	800	924	940	967	986	908	150	87	86
Marquis[2] x H-44	12012	24.8	57.2	16.2	16.0	69.8	.59	2.0	66.0	747	899	941	979	979	892	152	86	87
Thatcher	10003	27.1	57.3	16.4	15.5	71.0	.46	2.0	65.0	789	873	908	964	964	884	150	87	89
Regent	11869	25.5	57.1	16.5	16.1	71.7	.57	2.0	65.5	757	849	922	971	971	875	151	84	86
H-44 x Thatcher	12041	25.4	56.8	16.5	15.6	70.3	.52	2.0	66.5	752	865	921	940	940	870	151	80	87
Hope x Thatcher[3]	12044	26.8	57.1	16.6	15.8	73.2	.58	2.0	67.0	750	853	898	955	955	864	151	80	84
Hope x Thatcher[3]	12043	25.2	57.3	16.9	16.1	72.5	.57	2.3	68.5	755	851	892	924	934	856	154	83	87
C.-D.C. x C.-H.-F.[2]	12007	25.0	58.9	17.6	16.3	70.9	.52	2.3	69.0	750	843	881	907	907	845	153	93	90
Merit x Thatcher	12037	27.0	56.6	16.4	15.8	70.5	.57	2.5	71.0	694	839	899	944	944	844	156	88	84
H-44 x Thatcher	12040	24.7	58.5	16.0	15.3	72.6	.59	2.0	67.5	754	878	849	895	915	844	152	89	85
Comet-1121 x C-H-F[3]	12047	25.2	58.3	16.5	15.6	71.9	.60	2.0	65.0	675	814	908	947	947	836	150	86	85
H-44 x Marquis	12042	25.0	58.5	16.0	15.4	71.5	.53	2.3	68.5	709	818	890	919	920	834	153	89	89
Hope x Supreme	12038	25.6	57.4	16.3	15.5	72.0	.61	2.3	68.5	712	810	894	911	911	832	154	78	84
Reliance x Hope	11934	21.3	57.3	17.0	16.7	71.6	.60	2.0	64.0	706	845	856	908	908	829	148	78	81
Comet x Reliance-Hope	12049	25.7	59.1	16.2	15.0	73.4	.49	2.0	63.0	699	804	875	900	900	820	147	81	86
C-D.C. x C.-H.-F.[2]	12008	27.7	60.1	16.5	15.1	72.1	.50	2.0	66.5	701	833	855	885	885	819	152	89	86
Merit-3	12036	28.8	56.8	16.2	15.5	72.5	.53	2.5	71.5	643	790	884	937	937	814	157	77	80
Hope x Ceres	12058	25.5	58.7	16.2	15.0	71.2	.64	2.0	64.0	698	825	843	881	881	812	150	88	89
H-44 x Ceres	12010	26.0	57.6	16.8	16.5	71.6	.67	2.5	72.0	660	784	883	897	904	806	155	78	78
Reliance-Hope x Reward	12059	23.4	61.4	15.9	15.1	71.2	.68	2.0	64.0	724	836	798	853	863	803	148	80	82
Marquis	3641	18.3	55.8	15.3	14.5	67.8	.50	2.0	64.0	689	785	833	882	882	797	150	85	83
Ceres x Hope-Ridit	12039	26.0	58.1	15.4	14.8	70.5	.54	2.3	70.5	680	806	819	851	870	789	155	81	86
Mercury[2] x Comet-N.No. 1018	12046	27.9	58.3	15.6	14.3	72.7	.64	2.0	67.0	666	805	812	837	849	780	152	81	82
C.-D.C. x C.-H.-F.[2]	12005	26.3	57.0	15.7	14.9	72.7	.51	2.0	66.0	636	788	836	858	862	780	152	80	82
H-44 x Ceres	12048	27.5	59.3	15.9	15.7	72.4	.72	2.3	70.0	637	780	794	827	832	760	154	74	78
Mercury[2] x Comet-N.No.1018	12045	27.3	57.4	15.1	14.3	73.4	.55	2.0	67.0	610	745	818	862	862	759	154	78	80
Average		25.6	57.9	16.2	15.5	71.6	.57	2.1	67.1	707	829	871	908	912	829	152	83	84
Range		10.5	5.6	2.5	2.4	5.6	.26	0.5	9.0	190	179	147	152	154	149	9	19	12

1/ Standard error (Variety x Method interaction) for a single determination = 22.7 cc.
2/ Ceres-Double Cross x Ceres-Hope-Florence.
3/ Comet-N.No. 1121 x Ceres-Hope-Florence.

COMPARISON OF ALLIS-CHALMERS AND BUHLER MILLS

The production of flour by means of an experimental mill has always been a problem not only because of the time-consuming nature of the procedure but because some millers are not always able to produce a uniform flour with the equipment at their command. The Allis-Chalmers mill which requires the manual transfer of stock and considerable handling of the ground material has long been one type of milling unit used in the Department of Agriculture. In 1935, the Buhler Company of Uzwil, Switzerland, designed and built an automatic experimental mill which embodied many desirable features. The Buhler mill contains conveyors and elevators and requires no handling of the stock from the time the wheat is first introduced into the mill until the flour is made. A Buhler mill was purchased recently and some experiments have been made to determine its use for certain types of laboratory work. With this in mind, a comparison of the Buhler and Allis-Chalmers mill was made using the 8 uniform hard red spring wheat varieties from the western composite samples. The quality results from this study are shown in table 17. In addition to the 4 standard baking methods used by the laboratory, the baking methods for testing the bromate response similar to those employed by the Kansas Hard Red Winter Regional Laboratory were used. These latter results are shown in table 18.

A summary of the milling study (table 17) indicates that there are significant differences between some quality values for the flour made from each of the mills.

The Buhler-milled samples average lower in flour yield, higher in ash content and water absorption. There was no significant difference between the mills as to baking characteristics, protein content of flour, or mixing time of dough. The Allis-Chalmers-milled samples averaged slightly better in grain, texture, and crumb color of the bread although in the instance of some of the varieties no differences were found.

The response to varying amounts of Potassium Bromate (0 to 3 milligrams per 100 grams of flour) as shown in table 18 verifies the results in table 17 where on the average 1 milligram of bromate produces a larger loaf volume and additional amounts decrease the volume. The baking method of the Kansas Hard Red Winter Regional Laboratory appears to give similar results, except for a slightly higher loaf volume with some of the varieties, as compared to the baking methods usually employed in this laboratory for testing the hard red spring wheats.

Table 17. - Yield and chemical data, and a comparison of milling and baking results of the Allis-Chalmers and Buhler milled flours from the western composite of the uniform varieties grown in plot experiments in 1940

Variety	C.I. number	Acre yield	Test weight	Protein content			Flour				Mixing time 1/	Water absorption	
				Wheat	Flour		Yield		Ash				
					Allis	Buhler	Allis	Buhler	Allis	Buhler		Allis	Buhler
		(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Min.)	(Pct.)	(Pct.)
Marquis	3641	10.9	56.3	16.8	15.8	15.8	67.9	60.2	.69	.63	2.0	63.0	66.0
Ceres	6900	12.4	58.3	16.5	15.6	16.2	69.5	47.7	.56	.62	2.0	67.0	70.0
Thatcher	10003	12.9	55.8	17.2	16.5	17.0	69.6	67.5	.58	.59	2.0	68.0	71.0
Pilot-B	11428	11.2	55.6	17.1	16.0	15.8	68.7	64.3	.56	.63	2.0	68.0	71.0
Rival	11708	11.4	56.2	15.9	14.9	14.9	70.6	57.6	.58	.80	2.0	66.0	70.0
Renown	11947	10.2	57.2	16.8	16.0	15.8	72.3	64.5	.64	.58	2.0	63.0	66.0
Merit	11870	11.3	55.3	16.6	15.4	15.5	70.3	59.3	.62	.64	2.5	72.0	74.0
Premier	11940	12.1	58.0	15.9	15.0	15.2	69.0	59.5	.58	.64	2.0	69.0	72.0
Average		11.6	56.6	16.6	15.7	15.8	69.7	60.1	.60	.64	2.1	67.0	70.0
Range		2.7	3.0	1.3	1.6	2.1	4.4	9.9	.13	.22	0.5	9.0	8.0

Variety	C.I. number	Baking method and volume of loaf (Cc)											Average weight of loaf		Average crumb color		Average grain texture	
		No. 1		No. 2		No. 3		No. 6		Average		Average						
		Allis	Buhler	Allis	Buhler	Allis	Buhler	Allis	Buhler	Allis	Buhler	Both mills	Allis	Buhler	Allis	Buhler	Allis	Buhler
													(Grams)		(Score)		(Score)	
Marquis	3641	688	688	830	792	960	891	991	919	867	823	845	149	153	86	73	85	79
Ceres	6900	712	715	873	867	936	893	945	962	867	859	863	152	155	88	83	84	79
Thatcher	10003	778	775	896	885	994	950	1038	986	927	899	913	152	154	80	80	78	78
Pilot-B	11428	738	716	882	829	962	942	977	982	890	867	879	153	155	81	81	76	76
Rival	11708	655	680	803	821	908	847	976	900	836	812	824	152	156	83	84	79	78
Renown	11947	686	680	786	809	948	945	962	985	846	855	850	149	152	81	83	84	80
Merit	11870	671	677	787	795	902	911	936	942	824	831	828	158	159	75	74	75	73
Premier	11940	643	651	764	755	876	844	913	908	799	790	794	156	158	81	73	76	71
Average		696	698	828	819	936	903	967	948	857	842	849	153	155	82	79	80	77
Range		135	124	132	130	118	106	125	86	128	109	119	9	7	13	11	10	9

1/ Mixing time same for both Allis-Chalmers and Buhler mills.

Table 18. - Baking results showing bromate response for the western composite of uniform varieties of spring wheats grown in plot experiments in 1940

Variety	C.I. number	Loaf volume (cc)											Average weight of loaf		Average crumb color		Average grain texture	
		Milligrams of potassium bromate																
		0		1		2		3		Average								
		Allis	Buhler	Allis	Buhler	Allis	Buhler	Allis	Buhler	Allis	Buhler	Both mills	Allis	Buhler	Allis	Buhler	Allis	Buhler
													(Grams)		(Score)		(Score)	
Thatcher	10003	934	988	1018	1003	1047	971	945	874	986	959	973	155	157	80	79	81	80
Pilot-B	11428	914	920	1024	979	1018	976	948	876	976	938	957	155	158	79	75	85	83
Ceres	6900	914	974	994	970	948	925	879	865	934	934	934	155	157	85	74	83	81
Renown	11947	853	905	1003	1006	945	965	882	893	921	942	932	151	154	81	79	84	83
Marquis	3641	885	911	1015	930	1000	885	888	803	947	882	915	152	154	80	73	84	80
Merit	11870	853	908	943	965	920	922	891	844	902	910	906	159	160	80	79	83	80
Premier	11940	829	859	920	871	920	879	815	844	871	863	867	156	159	81	79	83	81
Rival	11708	801	873	896	920	925	871	823	806	861	868	864	155	157	79	76	83	79
Average		873	917	977	956	965	924	884	851	925	912	918	155	157	81	77	83	81
Range		133	129	128	86	127	105	133	90	125	96	109	8	6	6	6	4	4

COMMERCIAL HARD RED SPRING WHEATS OBTAINED THROUGH THE FIELD OFFICES OF THE GRAIN AND SEED DIVISION

In recognition of the need for information relative to the milling, chemical, and baking properties of the commercial types of wheat grown by farmers, as compared to the quality data obtained on the varieties produced in experimental plots, plans were made by the United States Department of Agriculture, through the Agricultural Marketing Service, Grain and Seed Division, to obtain a number of commercially grown wheat samples.

Moreover, a second purpose was to investigate the validity of the different varietal testing methods on commercial lots of wheat. As a result of this request, 8 wheat samples representing a number of grades and types were obtained at Minneapolis, Minn.; Great Falls, Mont.; and Spokane, Wash. The samples were composited by grade from cars of wheat grading No. 3 or better and represent the better grades of hard red spring wheats received at those markets. The quality results are given in table 19.

These results do not appear to be greatly different from those obtained for the experimental plot material. This observation is based on the comparison of samples having similar test weights and protein contents.

Table 19. - Chemical, milling, and baking results on 8 composite samples of commercial hard red spring wheat grades obtained at Minneapolis, Minn.; Great Falls, Mont.; and Spokane, Wash.

Location where obtained	Composited from	U. S. Grade	Test weight [1]	Protein content [2]		Flour		Water absorption average	Baking method and volume of loaf				Average weight of loaf	Average crumb color	Average grain texture
				Wheat	Flour	Yield [3]	Ash [4]		No. 2	No. 3	No. 6	Average			
			(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Minneapolis, Minn.	156 cars	1 Hvy.D.N.S.	60.6	13.1	12.7	72.1	.51	64.0	746	726	755	742	152	83	90
	589 cars	1 D.N.S.	59.5	13.9	13.9	71.5	.49	64.0	781	771	792	781	151	88	89
	227 cars	2 D.N.S.	58.0	14.5	14.3	71.0	.40	64.0	843	855	876	858	151	88	88
	192 cars	3 D.N.S.	57.0	15.2	14.8	71.1	.53	64.0	886	901	941	909	149	87	88
Great Falls, Mont.	25 cars	1 N.S.	59.4	12.6	12.6	71.9	.46	64.0	788	746	793	776	151	85	85
	162 cars	1 Hvy.D.N.S.	61.5	14.7	14.3	72.6	.47	64.0	860	834	861	852	150	89	93
	98 cars	1 D.N.S.	59.4	15.4	15.7	71.3	.49	64.0	840	901	926	889	150	85	93
Spokane, Wash.	94 cars	1 Hvy.D.N.S.	60.2	15.3	15.3	72.3	.47	64.0	844	872	904	873	150	91	92

1/ Dockage free basis.
2/ 13.5 percent moisture basis.
3/ Moisture free basis.
4/ 13.5 percent moisture basis.

SUMMARY OF THE QUALITY FACTORS FOR LEADING VARIETIES

In table 20 is presented 1940 averages of the chemical, milling, and baking properties of 12 leading varieties and strains, together with the averages of comparable samples of Thatcher and the difference shown in percentage of Thatcher. These are the uniform varieties grown in the region and the most promising new strains available from the nursery and plot experiments. Of the 8 uniform varieties, all are commercially grown except Merit and Premier. The new strains are Pilot-13, Regent, Vesta, Ceres-Double Cross x Ceres-Hope-Florence (Ns. 2829), and H-44 x Thatcher (II-29-52). From 1 to 12 comparisons are available for these varieties from the 1940 crop. The results from so few tests in one year are not conclusive.

In table 21 the annual and average results for 3 years are shown in percentages of Thatcher. The total number of tests of each variety during these years are shown also. From 8 to 36 tests have been made for the different varieties, the weighted average of which should give a fairly reliable index of their quality characteristics. For each property, the varieties are ranked in order of their 1940 results from which a comparison can be made with the results of the 2 previous years and the averages of the three.

The results will not be discussed by varieties as they are in the two previous reports, and as the summary tables 20 and 21 should serve for the present use.

Table 20. - Average of the chemical, milling, and baking properties of 12 wheat varieties, the average of comparable samples of Thatcher and of each variety in percentage of Thatcher, with the varieties arranged in order of percentage for loaf volume, 1940

Variety	No. of samples	Test weight per bushel (dockage free)	Crude protein of wheat	Yield of flour	Ash in flour 1/	Water absorption of flour	Baking method and volume of loaf					Grain 2/ texture	Crumb 2/ color	Average of 8 properties 3/
							No. 1	No. 2	No. 3	No. 6	Average			
		(Pounds)	(Percent)	(Pct.)	(Pct.)	(Percent)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Score)	(Score)	
Renown	6	59.5	15.9	71.8	.56	65.2	716	833	894	922	841	87	85	
Thatcher	6	57.4	15.5	71.1	.56	66.0	713	844	888	918	841	88	84	100.0
Percent of Thatcher		103.7	102.6	101.0	100.0	98.8	100.3	98.7	100.7	100.4	100.0	98.9	101.2	100.8
Regent	7	56.5	16.1	71.2	.60	66.3	713	848	914	944	855	83	84	
Thatcher	7	57.3	15.7	71.2	.52	65.9	744	861	906	945	864	89	86	
Percent of Thatcher		98.6	102.5	100.0	115.4	100.6	95.8	98.5	100.9	99.9	99.0	93.3	97.7	97.0
Pilot-13	11	57.4	15.9	69.2	.50	66.7	711	853	884	913	840	86	84	
Thatcher	11	57.0	16.1	70.3	.50	66.3	725	848	909	930	853	88	84	
Percent of Thatcher		100.7	98.8	98.4	100.0	100.6	98.1	100.6	97.2	98.2	98.5	97.7	100.0	99.3
Pilot-B	12	57.1	16.3	69.3	.54	66.3	714	843	890	910	839	84	82	
Thatcher	12	56.8	16.2	70.4	.52	66.8	722	850	921	947	860	87	84	
Percent of Thatcher		100.5	100.6	98.4	103.8	99.3	98.9	99.2	96.6	96.1	97.6	96.6	97.6	98.4
Vesta	1	61.4	15.2	74.5	.52	69.0	686	830	885	920	830	86	86	
Thatcher	1	59.1	15.2	70.7	.50	69.0	746	874	939	977	884	89	83	
Percent of Thatcher		103.9	100.0	105.4	104.0	100.0	92.0	95.0	94.2	94.2	93.9	96.6	103.6	99.9
H-44 x Thatcher, II-29-52	5	56.6	15.5	71.9	.56	66.0	643	807	836	857	786	85	83	
Thatcher	5	57.1	15.3	70.5	.53	66.2	703	839	888	926	839	89	84	
Percent of Thatcher		99.1	101.3	102.0	105.7	99.7	91.5	96.2	94.1	92.5	93.7	95.5	98.8	98.1
Ceres	6	56.4	15.2	67.8	.53	67.3	670	792	807	837	777	82	79	
Thatcher	6	57.3	15.6	70.8	.54	66.3	699	831	892	931	838	86	83	
Percent of Thatcher		98.4	97.4	95.8	98.1	101.5	95.9	95.3	90.5	89.9	92.7	95.3	95.2	96.4
Marquis	8	54.9	15.0	66.7	.57	64.0	677	794	843	849	791	86	83	
Thatcher	8	57.1	16.1	70.8	.53	65.9	751	854	910	943	865	87	83	
Percent of Thatcher		96.1	93.2	94.2	107.5	97.1	90.1	93.0	92.6	90.0	91.4	98.9	100.0	95.4
Merit	12	56.9	15.7	70.5	.58	71.4	622	770	841	877	778	82	81	
Thatcher	12	56.8	16.2	70.4	.52	66.8	722	850	921	947	860	87	84	
Percent of Thatcher		100.2	96.9	100.1	111.5	106.9	86.1	90.6	91.3	92.6	90.5	94.3	96.4	96.7
Rival	9	57.5	15.3	70.2	.57	68.4	628	788	806	837	764	82	81	
Thatcher	9	57.4	15.7	70.6	.53	66.9	709	845	901	927	846	87	84	
Percent of Thatcher		100.2	97.5	99.4	107.5	102.2	88.3	93.3	89.5	90.3	90.3	94.3	96.4	96.6
Ns. 2829	9	60.6	15.3	72.2	.51	66.3	649	778	784	815	757	87	87	
Thatcher	9	57.4	16.0	70.6	.51	66.3	726	847	899	918	848	89	84	
Percent of Thatcher		105.6	95.6	102.3	100.0	99.8	89.4	91.9	87.2	88.8	89.3	97.8	103.6	99.3
Premier	9	59.1	15.0	70.0	.59	68.8	596	721	745	768	708	77	80	
Thatcher	9	57.4	15.7	70.6	.53	66.9	709	845	901	927	846	87	84	
Percent of Thatcher		103.0	95.5	99.2	111.3	102.8	84.1	85.3	82.7	82.8	83.7	88.5	95.2	94.6

1/ Reciprocal percentage values used in computing averages of 8 properties.
2/ Average volume color and texture for 4 methods of baking (Nos. 1, 2, 3, and 6).
3/ The 8 properties are test weight, crude protein, flour yield, ash (reciprocal values), water absorption, and average volume, grain texture, and crumb color.

Table 21. - Relative chemical, milling, and baking values of 13 varieties of hard red spring wheat in percentage of Thatcher for the years 1938, 1939, 1940, and weighted average

Test weight						Crude protein of wheat					
Variety	1938	1939	1940	Average	No. of exp.	Variety	1938	1939	1940	Average	No. of exp.
Ns. 2829	-----	-----	105.6	105.6	9	Renown	98.7	100.6	102.6	101.3	11
Vesta	104.5	101.9	103.9	103.4	15	Regent	106.0	103.1	102.5	103.2	13
Renown	107.0	101.4	103.7	103.7	11	II-29-52	-----	98.8	101.3	100.4	8
Premier	106.2	104.2	103.0	103.7	19	Pilot-B	104.0	96.1	100.6	100.1	29
Pilot-13	102.1	99.8	100.7	100.4	19	Thatcher	100.0	100.0	100.0	100.0	36
Pilot-B	103.0	100.0	100.5	101.0	29	Vesta	100.0	94.7	100.0	97.9	15
Merit	101.5	99.1	100.2	100.1	27	Pilot-13	96.0	93.5	98.8	96.7	19
Rival	105.1	100.7	100.2	101.9	26	Rival	100.0	94.2	97.5	97.1	26
Thatcher	100.0	100.0	100.0	100.0	36	Ceres	98.6	95.7	97.4	97.4	13
II-29-52	-----	97.2	99.1	98.4	8	Merit	100.6	95.5	96.9	97.3	27
Regent	101.5	97.0	98.6	98.6	13	Ns. 2829	-----	-----	95.6	95.6	9
Ceres	102.1	102.5	98.4	100.5	13	Premier	108.2	92.9	95.5	94.9	19
Marquis	100.0	100.7	96.1	98.0	14	Marquis	100.0	95.1	93.2	94.7	14

Flour yield						Ash of flour1/					
Variety	1938	1939	1940	Average	No. of exp.	Variety	1938	1939	1940	Average	No. of exp.
Vesta	104.0	102.8	105.4	103.6	15	Ceres	102.0	96.2	101.9	100.6	13
Ns. 2829	-----	-----	102.3	102.3	9	Pilot-13	116.3	102.0	100.0	101.6	19
II-29-52	-----	100.0	102.0	101.3	8	Ns. 2829	-----	-----	100.0	100.0	9
Renown	101.1	99.9	101.0	100.7	11	Renown	98.0	93.9	100.0	98.0	11
Merit	101.1	100.4	100.1	100.4	27	Thatcher	100.0	100.0	100.0	100.0	36
Regent	100.9	98.4	100.0	99.6	13	Pilot-B	100.0	100.0	96.2	98.4	29
Thatcher	100.0	100.0	100.0	100.0	36	Vesta	100.0	97.9	96.0	98.9	15
Rival	105.5	102.7	99.4	102.4	26	II-29-52	-----	96.3	94.3	95.1	8
Premier	103.1	102.8	99.2	101.1	19	Rival	103.9	96.0	92.5	97.2	26
Pilot-B	101.0	99.7	98.4	99.5	29	Marquis	100.0	98.1	92.5	95.2	14
Pilot-13	97.0	98.7	98.4	98.4	19	Premier	100.0	98.0	88.7	93.7	19
Ceres	102.4	100.3	95.8	98.9	13	Merit	96.0	96.0	88.5	92.7	27
Marquis	100.0	98.3	94.2	96.2	14	Regent	96.0	88.7	84.6	87.6	13

Water absorption of flour						Loaf volume, Basic method, No. 1					
Variety	1938	1939	1940	Average	No. of exp.	Variety	1938	1939	1940	Average	No. of exp.
Merit	104.2	106.0	106.9	106.0	27	Renown	92.1	89.9	100.3	96.0	11
Premier	108.0	105.6	102.8	104.4	19	Thatcher	100.0	100.0	100.0	100.0	36
Rival	103.9	100.5	102.2	102.1	26	Pilot-B	102.3	95.1	98.9	98.7	29
Ceres	102.9	97.7	101.5	101.1	13	Pilot-13	110.4	97.9	98.1	98.7	19
Pilot-13	100.0	98.5	100.6	99.8	19	Ceres	96.3	93.6	95.9	95.5	13
Regent	100.7	99.1	100.6	100.2	13	Regent	94.9	89.5	95.8	93.7	13
Vesta	101.0	99.8	100.0	100.5	15	Vesta	96.7	86.4	92.0	91.7	15
Thatcher	100.0	100.0	100.0	100.0	36	II-29-52	-----	88.3	91.5	90.3	8
Ns. 2829	-----	-----	99.8	99.8	9	Marquis	94.3	94.2	90.1	91.9	14
II-29-52	-----	97.7	99.7	98.9	8	Ns. 2829	-----	-----	89.4	89.4	9
Pilot-B	99.0	99.1	99.3	99.2	29	Rival	101.8	93.6	88.3	94.3	26
Renown	100.0	99.7	98.8	99.3	11	Merit	91.5	85.4	86.1	87.1	27
Marquis	100.0	94.8	97.1	96.9	14	Premier	102.2	84.8	84.1	85.4	19

Table 21. - (Continued)

Loaf volume, Commercial method, No. 2					
Variety	1938	1939	1940	Average	No. of exp.
Pilot-13	119.1	102.2	100.6	102.2	19
Thatcher	100.0	100.0	100.0	100.0	36
Pilot-B	104.7	98.3	99.2	100.4	29
Renown	95.0	91.9	98.7	96.2	11
Regent	93.7	96.6	98.5	97.2	13
II-29-52	------	95.5	96.2	95.9	8
Ceres	102.0	96.8	95.3	97.7	13
Vesta	96.0	91.5	95.0	94.1	15
Rival	101.0	95.5	93.3	96.4	26
Marquis	98.6	97.8	93.0	95.2	14
Ns. 2829	------	------	91.9	91.9	9
Merit	96.0	90.5	90.6	91.8	27
Premier	100.4	87.5	85.3	87.1	19

Loaf volume, Commercial-bromate method, No. 3					
Variety	1938	1939	1940	Average	No. of exp.
Regent	100.6	98.9	100.9	100.2	13
Renown	97.5	95.1	100.7	98.6	11
Thatcher	100.0	100.0	100.0	100.0	36
Pilot-13	107.6	95.5	97.2	97.1	19
Pilot-B	106.0	95.6	96.6	98.9	29
Vesta	96.6	86.3	94.2	92.3	15
II-29-52	------	93.0	94.1	93.7	8
Marquis	96.5	92.6	92.6	93.1	14
Merit	96.3	90.3	91.3	92.1	27
Ceres	98.6	92.3	90.5	93.4	13
Rival	100.7	92.3	89.5	93.9	26
Ns. 2829	------	------	87.2	87.2	9
Premier	98.2	85.8	82.7	85.0	19

Loaf volume, Commercial-Bromate + Malted wheat flour method, No. 6 2/					
Variety	1938	1939	1940	Average	No. of exp.
Renown	93.9	98.8	100.4	98.8	11
Thatcher	100.0	100.0	100.0	100.0	36
Regent	109.8	100.1	99.9	101.5	13
Pilot-13	84.9	94.8	98.2	96.2	19
Pilot-B	97.7	96.7	96.1	96.7	29
Vesta	97.0	87.2	94.2	92.9	15
Merit	100.3	93.3	92.6	94.5	27
II-29-52	------	90.2	92.5	91.6	8
Rival	95.4	94.2	90.3	93.2	26
Marquis	94.2	90.9	90.0	90.9	14
Ceres	95.6	91.9	89.9	92.1	13
Ns. 2829	------	------	88.8	88.8	9
Premier	93.7	87.8	82.8	85.7	19

Loaf volume, average of 4 methods					
Variety	1938	1939	1940	Average	No. of exp.
Renown	94.7	94.3	100.0	97.5	11
Thatcher	100.0	100.0	100.0	100.0	36
Regent	100.2	96.7	99.0	98.5	13
Pilot-13	103.9	97.4	98.5	98.4	19
Pilot-B	102.4	96.2	97.6	98.5	29
Vesta	96.5	87.7	93.9	92.8	15
II-29-52	------	91.8	93.7	93.0	8
Ceres	98.1	93.5	92.7	94.5	13
Marquis	96.7	93.8	91.4	92.8	14
Merit	96.3	89.9	90.5	91.6	27
Rival	99.6	93.8	90.3	94.4	26
Ns. 2829	------	------	89.3	89.3	9
Premier	98.2	86.5	83.7	85.8	19

Crumb color, average of 4 methods					
Variety	1938	1939	1940	Average	No. of exp.
Ns. 2829	------	------	103.6	103.6	9
Vesta	112.3	96.4	103.6	105.4	15
Renown	98.2	98.8	101.2	100.0	11
Pilot-13	134.0	103.1	100.0	102.9	19
Marquis	92.6	104.2	100.0	100.1	14
Thatcher	100.0	100.0	100.0	100.0	36
II-29-52	------	93.8	98.8	96.9	8
Regent	97.5	95.7	97.7	97.1	13
Pilot-B	103.4	98.7	97.6	99.5	29
Merit	106.0	94.1	96.4	97.8	27
Rival	108.6	98.2	96.4	100.8	26
Premier	108.3	96.5	95.2	96.5	19
Ceres	95.3	100.0	95.2	96.3	13

Grain and texture, average of 4 methods					
Variety	1938	1939	1940	Average	No. of exp.
Thatcher	100.0	100.0	100.0	100.0	36
Marquis	91.1	100.8	98.9	98.3	14
Renown	98.4	101.4	98.9	99.5	11
Ns. 2829	------	------	97.8	97.8	9
Pilot-13	113.1	99.6	97.7	99.2	19
Pilot-B	105.2	100.0	96.6	100.0	29
Vesta	97.7	93.1	96.6	95.8	15
II-29-52	------	94.1	95.5	95.0	8
Ceres	93.7	103.7	95.3	96.7	13
Merit	94.7	93.6	94.3	94.2	27
Rival	99.3	99.0	94.3	97.5	26
Regent	95.8	93.5	93.3	93.7	13
Premier	91.2	94.7	88.5	91.6	19

1/ Reciprocal percentage values used here and in computing averages for 8 properties.
2/ In 1938 the Malt-Phosphate-Bromate Method, No. 4, was used instead of Method No. 6.